This report was funded by the Bonneville Power Administration (BPA), U.S. Department of Energy, as part of BPA's program to protect, mitigate, and enhance fish and wildlife affected by the development and operation of hydroelectric facilities on the Columbia River and its tributaries. The views in this report are the author's and do not necessarily represent the views of BPA.

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SOUTH FORK CLEARWATER RIVER HABITAT ENHANCEMENT

CROOKED AND RED RIVERS

ANNUAL REPORT - 1989

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Contract Number DE-AI79-84BP16475
Project Number 84-5

January, 1990

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CROOKED RIVER

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ABSTRACT

In 1983, the Nez Perce National Forest and the Bonneville Power Administration entered into an interagency agreement (Project 84-5) to enhance and improve habitat for two anadromous fish species, spring chinook salmon (Oncorhynchus tshawytscha) and summer steelhead trout (Onchorhyncus mykiss), in the South Fork Clearwater River tributaries.

The South Fork Clearwater River was dammed in 1927 for hydroelectric development. Anadromous fish runs were virtually eliminated until the dam was removed in 1962. To complicate the problem, upstream spawning and rearing habitats were severely impacted by dredge and hydraulic mining, road building, timber harvest, and over-grazing.

Fish habitat improvement projects under the above contract are being carried out in two major tributaries to the South Fork Clearwater River. Both the Red River and the Crooked River projects began in 1983 and will be completed in 1990.

INTRODUCTION

In 1983, the Nez Perce National Forest and the Bonneville Power Administration (B.P.A.) entered into an interagency agreement (Project 84-5) to rehabilitate and enhance habitat for anadromous fish In the South Fork Clearwater River. Project activities are being funded by B.P.A. as part of the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program.

In 1927, a dam was constructed on the South Fork of the Clearwater RIver at Harpster. The dam eliminated anadromous fish run access into this important spawning and rearing habitat. A fish ladder was constructed at the dam in 1935, but it was not successful in passing fish. In 1962 the dam was completely removed. By this time, however, the anadromous runs had been eliminated from the drainage.

Additional activities in the drainage that have impacted anadromous fish habitat include mining (both dredge and hydraulic), timber harvest, and road construction. These activities have resulted in degradation of riparian vegetation along stream banks, and increased sed iment loads in the streams. The erosive nature of the land types in the Idaho Batholith severely Impact the sedimentation situation.

The Idaho Department of Fish and Game (IDF&G) began a program of re-introduction of anadromous salmonids to the South Fork Clearwater River in 1962. Hatching channels were constructed on Red River at the Red River Ranger Station and on Crooked River near Orogrande. The channels were stocked annually with eyed eggs. The species of eggs stocked varied each year, and included coho salmon, spring chinook salmon, and summer steelhead trout. The Crooked River channel was abandoned several years ago when the lease on private land was terminated. However, the Red River channel is still in operation. Most of the recent use (1978-1987) has been with steelhead. In 1977 the IDF&G constructed a rearing pond at Red River which is used to rear 200,000 - 300,000 spring chinook salmon annually. The pond is stocked with fry in the spring. After rearing in the pond over the summer, a portion of the fish are marked, and all are released into Red River at the pond site.

During the summer of 1989, the U.S. Army Corps of Engineers started construction on 1.3 million dollar satellite hatchery facility on Crooked River. The project will include a spring chinook acclimation facility and an adult trap facility. The facility will be managed by the IDF&G. This satellite facility is designed to provide the capacity for trapping and holding 500 spring chinook and 640 steelhead adults returning to Crooked RIver. The smolt facility will release about 750,000 spring chinook smolts. The number of steelhead smolts to be released is not yet known. Operation of the satellite fish hatchery should accelerate production of fish and habitat usage.

The U.S. Forest Service (U.S.F.S.) began a habitat improvement program In the Red River, Crooked River, and Newsome Creek drainage systems in 1980. Projects activities are continuing on an annual basis utilizing Forest Service funding. Since the B.P.A. project proposal has been approved, the Elk City District has directed its Forest Service funded projects to Newsome Creek. The Newsome Creek project, along with other Forest Service funded enhancement projects will complement the B.P.A. work being carried out in Crooked River. The U.S.F.S. contribution to the rehabilitation of the South Fork Ciearwater system was $7,800 in 1983, $30,157 in 1984, $96,347 in 1985, $100,000 in 1986, $164,000 in 1987, $110,000 in 1988, and $75,000 in 1989.

Dredge mining between 1936 and 1958 has been the principle activity impacting Crooked River. Four different dredges were used on the river. Mining activities have greatly altered the riparian flood plain. Any large boulders encountered were worked around, moved, or allowed to drop Into holes created by the excavation. The fine sands, which were worked for gold, were dumped back into the water and filled the excavation to the water line. Most of the organic matter, silt and clay, were suspended and moved downstream. Pebbles and small boulders were passed through the dredge and placed above the the sand layer in the form of tailing piles. Materials in the plies range in size from sand particles to boulders about 12" in diameter. Sands have been washed from the surface of the piles, leaving them with a cobbled appearance. The river channel has re-armored itself with material from the tailings piles. As a result, the river is confined to the channel the dredges created during mining operations. The upper portion of Crooked RIver, above the narrows, was left in a straighten channel dominated by riffle habitat. The lower section was left in exaggerated 90 degree bends with a pool:rIffle ratio of 60:40.

DESCRIPTION OF PROJECT AREA

The Nez Perce National Forest is located in north central Idaho and supports a wide variety of fish species. The Forest has the habitat capability to produce approximately 10 percent of the summer steelhead and 9 percent of the spring chinook in the Columbia River basin. At thls time the Forest is not producIng fish at full potential. Production of wild anadromous smoits has been calculated at 351,000 steelhead and 470,000 sprlng chinook. Thls translates into roughly 8,000 adult steelhead and 8,000 adult salmon returnlng to the Forest each year to spawn.

HistorIcaily, Idaho's salmon and steelhead had approximately 5,200 miles of stream available as spawning and rearing habitat; 27,930 acres of steelhead and 27,208 acres of chinook habitat. Due to dam construction, road construction, and mining, Idaho lost 2,342 miles (41 percent) of anadromous stream habitat . The Nez Perce Forest contains 28 percent of the remainlng available miles and 38 percent of the available habitat acres In Idaho.

The Nez Perce National Forest project areas are located on the Elk City and Red River Ranger DistrIcts. The 1988 Crooked River project areas were located in Project Segments III and IV (Figure 1). All work was performed on U.S.F.S. land. There was some off-channel work performed in this area of Crooked River during 1986-1987.

In 1989, enhancement work was performed in project segments I, III, IV, and V (Figure 1). Because the channel in the lower section (segments III, and IV) of Crooked River was left In a over-meandering condition, the stream has to travel a longer distance in the same vertical drop as the natural system did. This has created an extremely low gradient (0.5-0.8%) in this section (segments I I I and IV) of river. Although there is a high amount of spawning gravels and pools in segments III-V, the low gradient adversely effects then, Sediment transported through the upper higher gradient areas are deposited out when they reach this meander section of river. Spawning gravels are also effectively "trapped" in this low grad lent area. The low gradient and high sediment deposition prevent gravels from beIng sorted into a utilizable form for salmonId spawning use.

This area of Crooked River has a limited amount of large woody debris in the river and vegetation growing on the banks. Dredge mining has effectively removed debris from the stream, and vegetation from the riparian area. The. disturbed area has not revegetated back successfully due to the harsh growing condition it was left in.

METHODS AND MATERIALS

Because of the scope of this project it was necessary to develop a systematic approach for evaluation, design, and execution of the projects. Original planning for the Crooked River project started in 1983 and planning has continued through the life of the project.

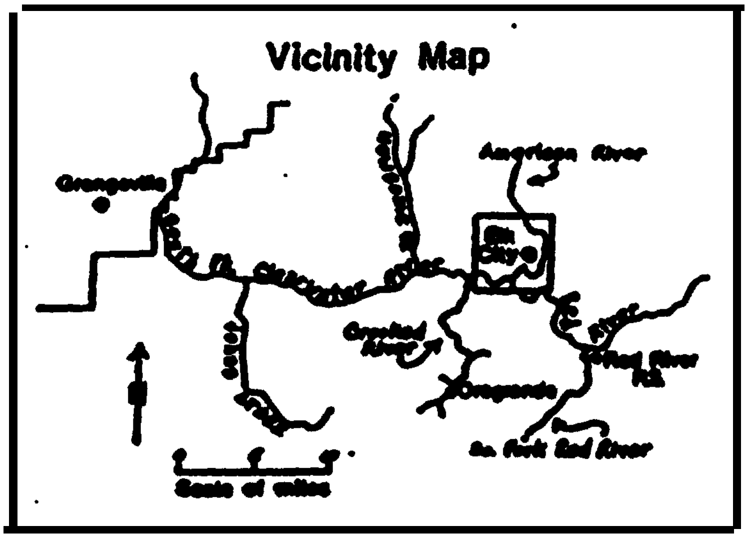
The first step was to separate the stream into reaches with similar characteristics. On Crooked River, each reach was considered a project segment. After stream reaches were selected, each reach was evaluated for fish habitat limiting factors, and potential habitat improvement projects were identif Ied.

In the out-year planning process for Crooked River, Elk City District contracted with The Envirosphere Company (Contract No. 53-1295-6-33) to develop alternatives for improving fish habitat in reaches III, IV, and V. These were the stream sections lacking previous enhancement work. These reaches were subdivided into 8 habitat units based on physical differences and habitat improvement needs (Figure 2). The agencies Involved met and selected the preferred alternatIves for each reach.

Objectives for this section of Crooked River were: (1) create a more natural channel with increased habitat diversity by providing spawning sites with 1-3" sorted gravels, cover for spawning adults, increase the quality and quantity of juvenile summer and winter habitat; (2) increase off-channel rearing areas for juveni le salmonids; (3) create a more stable stream channel by providIng a flood plain allowing sediment deposition out of the stream, and providing an area for establishment of riparian vegetation,

FIGURE 1

Crooked River Fish Habitat Improvement Project



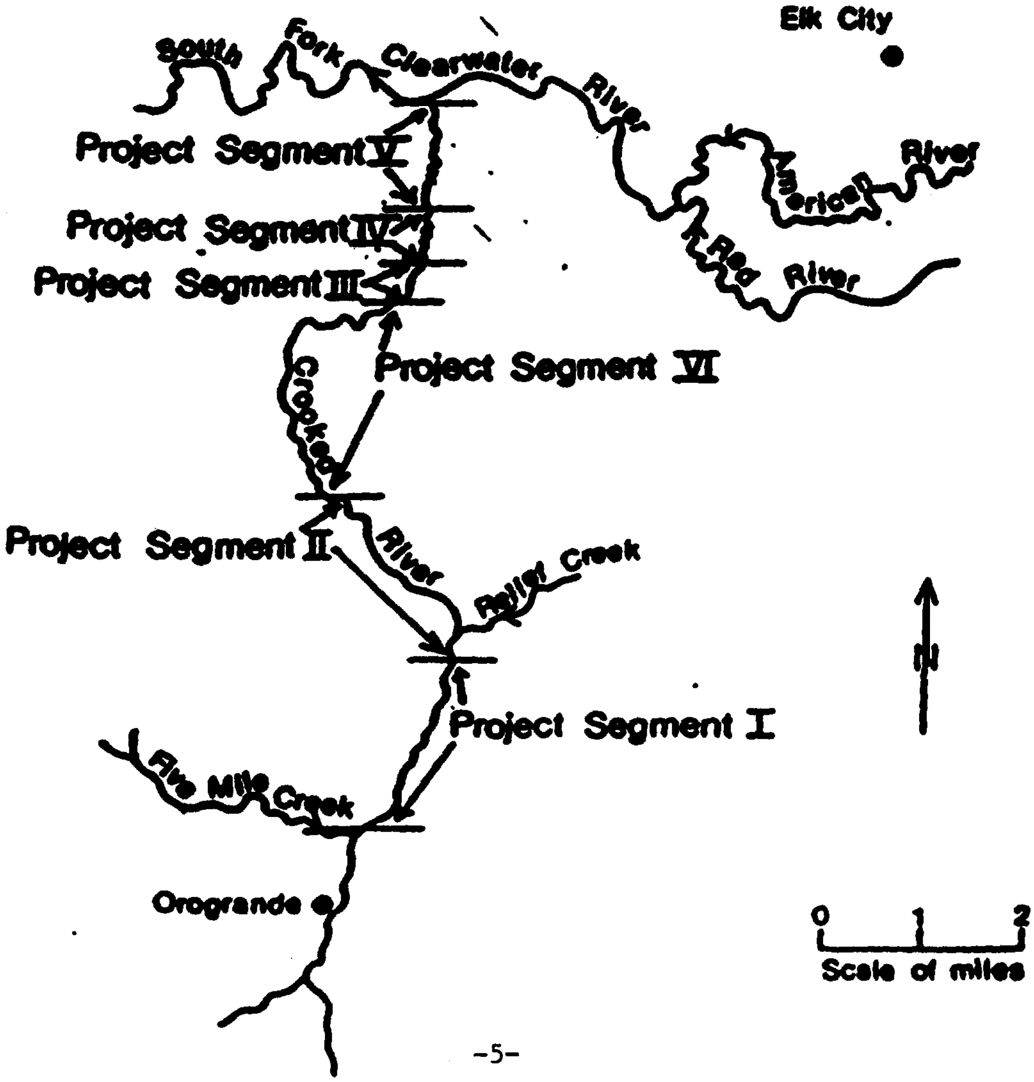
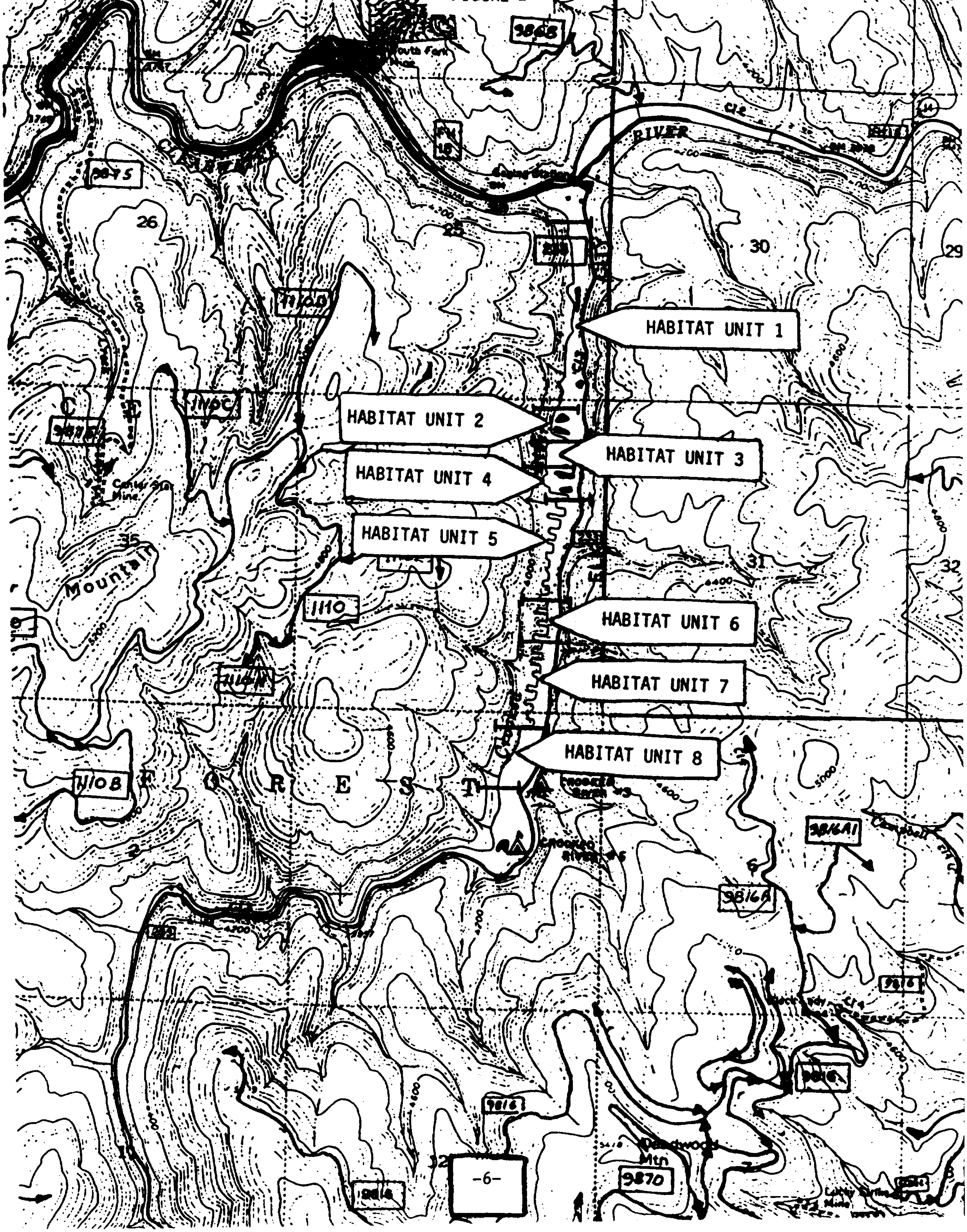


FIGURE 2


HABITAT UNIT 1
HABITAT UNIT 2
HABITAT UNIT 3
HABITAT UNIT 4
HABITAT UNIT 5
HABITAT UNIT 6
HABITAT UNIT 7
HABITAT UNIT 8
RIVER
Mountain
F O R E S T
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29
35
31
32
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9875
1100
1110
1108
9816A
9816A1
9816
9870

Methods used in 1983-1987 were standard fish habitat improvement techniques including log weirs, boulder weirs, random boulder placement, bank stabilization, riparian fencing and revegetation, flood plain and side channel construction, and connecting isolated ponds. The various treatments and methods were presented in detail in the 1984 and 1985 annual reports. These methods were used mainly in the straighten section of Crooked River (segments I & II), where pool habitat and stream debris were limited.

Although the 1988 and 1989 projects incorporated many of these designs, some unique techniques were needed for habitat units 8, 7 & 6. Plans for habitat enhancement for these units took place in 1987 and 1988. Habitat units 6,7 & 8 (segments III & IV) are located in the lower sections of Crooked River which were left in 90 degree bends or "L" configuration. Limiting factors were much different than the upper portions of the river. Much of the off-channel work was more complicated and require intensive planning. During the planning process the U.S.F.S., along with the IDF&G, Idaho Water Quality Department, and Nez Perce Tribe discussed possible alternatives for rehabilitating this section of Crooked River. While choosing desired alternatives for these habitat units, concerns where raised about possible major river rechannelization. The excavation of dredge piles during 1986 on the eastside of the river, left the ground between it and the side channel (excavated in 1987) lower than Crooked River's average water level. Because of the 90 degree channel configuration in this section of Crooked River, concerns of possible channel breaching during a large flood event were discussed. In 1987, a containment berm design was requested to be included in contract No. 53-0295-7-33 awarded to the firm of Nater and Environmental Services. The firm designed the plans and blue prints for all off-channel construction including berms, side channels, and pond connection.

The 1989 project used many of the designs that have proven effective in the previous projects. The majority of work included; boulder weirs, boulder/root wad placement, bank stabilization, side channel excavation, revegetation and maintenance of existing structures.

During 1986 and 1987 the Idaho State Division of Environment, Water Quality Department sampled water at established sampling stations throughout the B.P.A. project areas around Crooked River. The project was established to collect water quality data on ponds to be connected to the main channel of Crooked River, and to determine if this type of disturbance would effect the water quality of the river. These ponds had been excavated during the dredge mining process. This study was initiated because of concerns about these ponds containing possible contaminates caused by mining activities. All field work was performed during the 1986-87 field seasons. Data was then used to generate a final report during 1987-88. This report contains results of the water quality in the ponds, and recommendations for future off-channel work. This project will be discussed further in the Results section of this report.

RESULTS AND DISCUSSION

Crooked River - Habitat units 1-7, Project segments I, III, IV, VI

Off-channel enhancement:

Two side channels were constructed using a hydraulic track mounted excavator. One side channel located on the eastside of the river, in habitat unit 6, required the excavation of dredge tailings and placement of two 48"x20' culverts. Culverts were placed to control flows at the inlet and outlet of the channel. The other channel located in habitat unit 5 on the westside of the river required excavation of both inlet and outlet channels and a connecting channel (Fig. 3 and 4) between the ponds. This provided an additional 88,000 cubic feet of pond habitat. A control structure was installed in the connecting channel to regulate flows. Woody debris was added to the ponds to provlde fish cover for winter rearing habitat.

Instream Enhancement:

Objectives for instream enhancement for this section of Crooked River were to increase: cover for spawning adult salmonids, spawning habitat, winter rearing for Juvenile salmonids, and overall habitat diversity in this section of stream. Large rocks were used in formation of up stream V's, deflectors, and pinch weirs (Fig. 5,6, and 7) to create pools and wash sediment from spawning gravels. Root wads, trees, and boulders (Fig. 8,9, and 10) were placed to provide instream cover. Root masses and trees were either cabeled to boulders (using Hilti drill and epoxy) or keyed 3'-5' into the river banks for Increase bank cover.

Maintenance:

In habitat unit 4, maintenance was required for work performed during 1987. A downstream V was constructed in the main channel just below an outlet side channel. As water flowed over the structure, it caused widening of the channel below. Reconstructlon of the downstream V to an upstream V was conducted to concentrate the flows to the center of the channel, restricting a widening of the stream channel.

In habitat unit 7, reconstruction of a rock deflector was necessary to prevent the structure from washing out. Reconstruction of three flood plains built in 1987 was also necessary due to the river channel cutting through the flood plains. The flood plains were built up and reshaped with gravels from the surrounding tailing piles to help prevent any further cutting. (Fig. 12)

in 1986-87, a series of ponds were connected in project segment I. Due to the nature of dredge berms in which work was performed, subsurface flows were draining the ponds and connecting ponds. To prevent the subsurface flows, the 'lower pond and outlet channel were excavated and lined with filter cloth.

See table 1 for 1989 accomplishments.

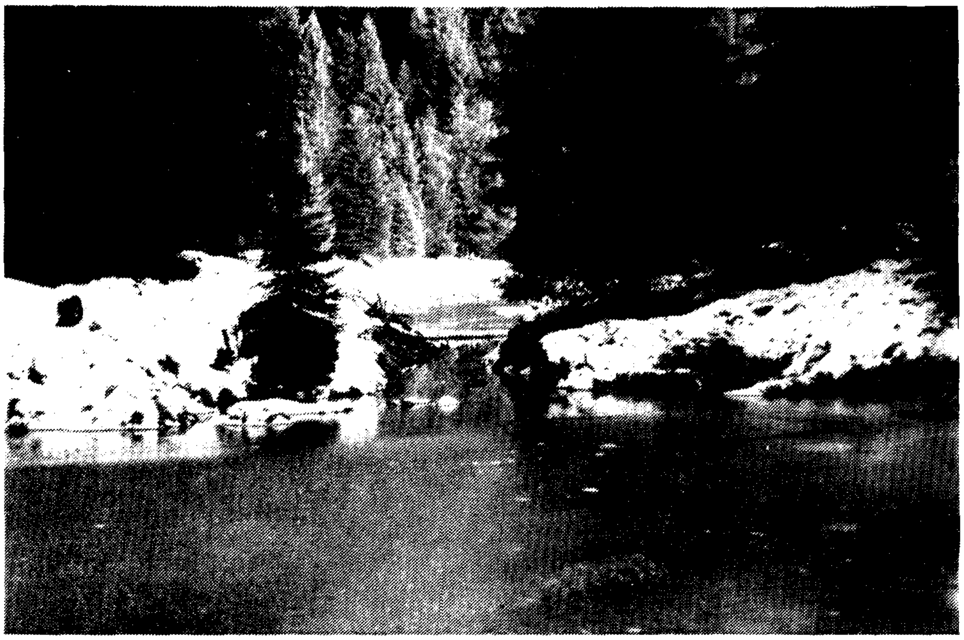

Figure 3 - Inlet Channel to Pond

Figure 4- Connecting Channel between 2 Ponds

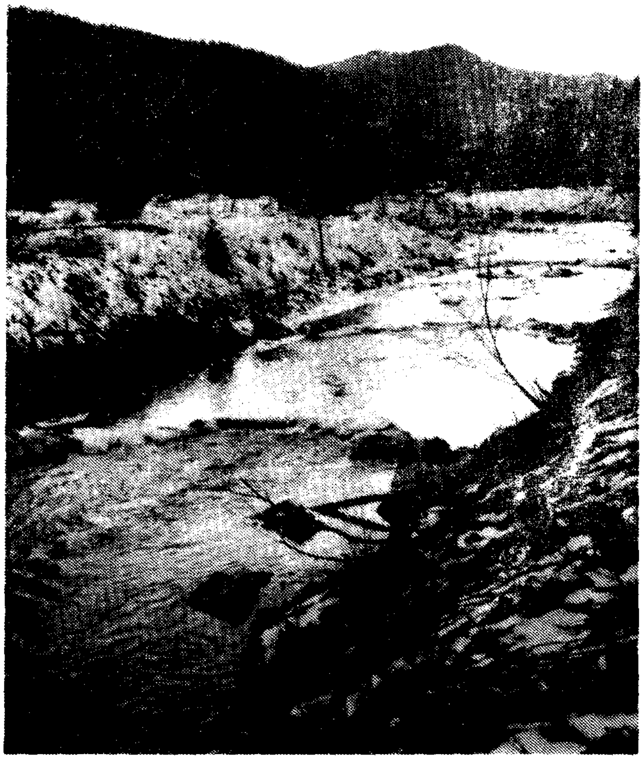

Figure 5 - Upstream V's

Figure 6 - Rock Deflector

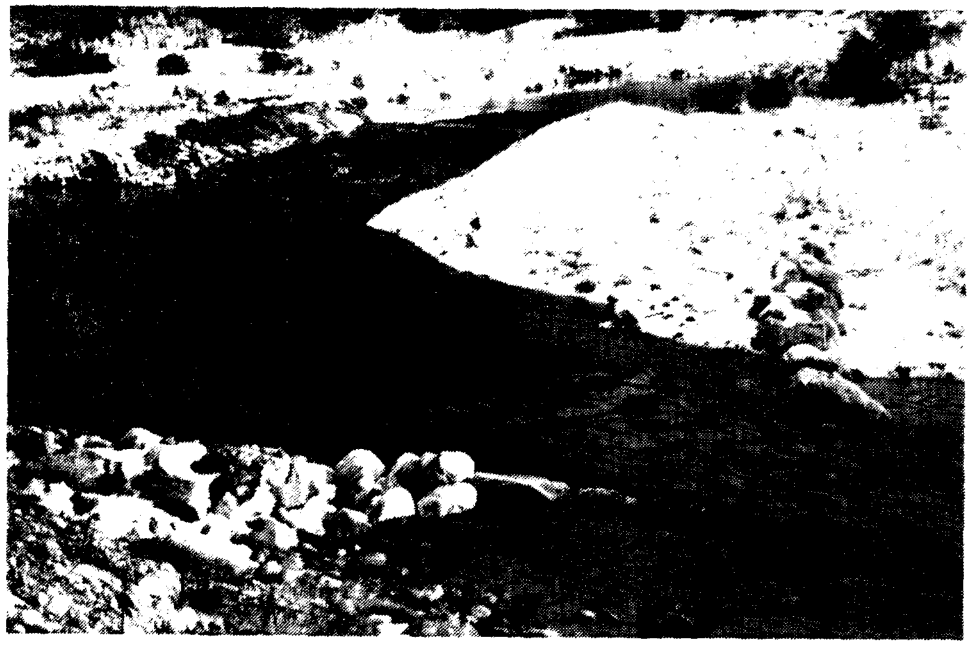

Figure 7 – Pinch weir

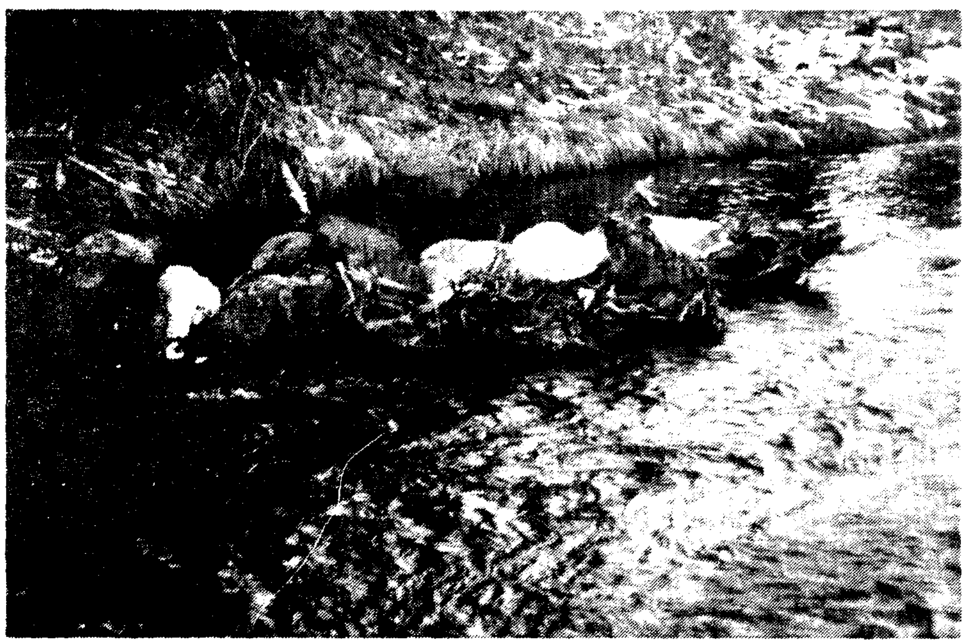

Figure 8 – Root Wad Clusters

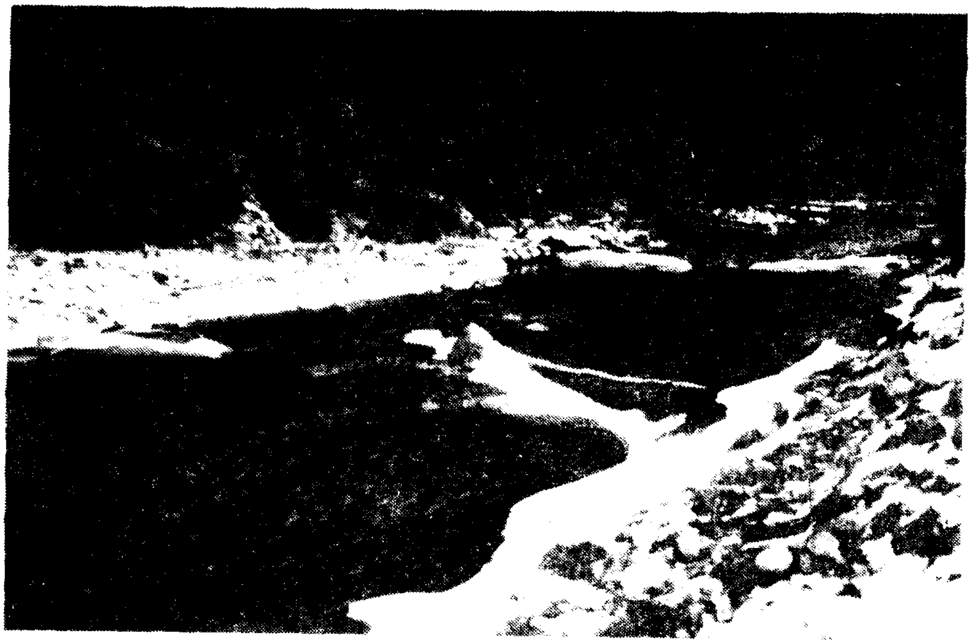

Figure 9 - Deflector Log

Figure 10 - Random Boulder Placement

TABLE 1
B.P.A. CROOKED RIVER - 1989

Enhancement Structures (Habitat Units 1-7)

New Structures-
25 boulder/root wads
19 boulder placements
26 deflectors
5 pinch weirs
30 cover trees
6 "V" weirs
4 riprap sites (75' total)
1 woody debris pile
4 inlet/outlet channels, pond development (2 culverts)
1 lining of pond and channel with filter cloth
4 flood plain maintenance (backfill)

125 Total

Maintenance

Wiliow Plantings - 200, 1 acre
Seed and Fertalizer - 5 acres
Conifer Plantings - 2,000, 1000/acre
Mulch - 15 straw bales
5 rolls of CURLEX, 1 acre

Water Quality Results:

The final report submitted by the Water Quality Bureau contained information and recommendations in planning 1988 project activities, and future off-channel project planning. Data was collected prior to and during connection of ponds in habitat unit 4. The resu l ts were used to determine i f disturbances of dredge ponds created during connection of the ponds to the river would mobilize any toxic levels of contamlnants. After analyzing data collected in 1986-1987, it was found that total and dissolved water column concentrations of arsenic, mercury, lead, and zinc in Crooked River and adjacent ponds to be below detection limits. In Crooked River, total iron exceeded Environmental Protection Agency freshwater criteria for aquatic life, but only during the construction phase of channels. "Although the data indicated that total iron levels sometimes exceeded criterla, the dissolved fraction did not and accordingly was not in a form that would affect the biota of Crooked RI ver" (Water Qual i-l-y Status Report No.80).

After the water quality study was completed in 1987, the State of Idaho recommended the following precautions for future work on Crooked River: (1) activities need to be planned so that large volumes of dredge pond water are not rapidly introduced to Crooked River; (2) stream flow should be monitored continually during project construction (connection of ponds and other off channel work) to assure that the downstream reaches of Crooked River are not dewatered to a point affecting beneficial uses; (3) avoid construction during salmonid spawning periods; (4) implement off-channel enhancement efforts only in dredge ponds similar to those selected in the test study. (5) include customary precautions to reduce the sedimentation problems common to such activities. Customary precautions include, complete excavation in upstream ponds by first allowing fines to settle before constructing the outlet channel, prevent disturbance of pond and stream banks, and keeping machinery activities to a minimum in the main channel of the river. Such precautions will continue to be addressed throughout the duration of the Crooked River Project. A copy of the Water Qual i ty Status Report No. 80 is available upon request from the Idaho Department of Health and Welfare, Division of Environmental Quality, Water Quality Bureau Boise, Idaho.

SUMMARY AND CONCLUSIONS

Future monitoring of the 1989 B.P.A. project work will be needed to evaluate the benefits for both adult and juvenile salmonid use. In the past, much of the project monitoring concentrated on juvenile salmonid usage. Much benefit can be obtained by increasing the quality of spawning habitat available for salmonid use. Although this area had high quantities of quality sized gravels (2"-4"), it is not known for high salmonid spawning use. Gravels were deposited in a non-utilizable form, and adult hiding cover was not available to provide secure holding water. IDF&G annually monitors Crooked River for salmonid spawning use. During the fall of 1989 several pair of adult chinook salmon were observed utilizing structures in this area for cover. IDF&G reported 8 chinook redds in this area. All redds were in gravels associated with structures. Although it is early for final evaluation of this project, potential appears to exist for an increase in adult spawning usage of this area in the future. Increasing the production of wild stocks of juvenile salmonids may increase seeding of rearing habitat created and improved during the B.P.A. project.

Riparian habitat improvements such as flood plain development, will take time before the "full effects" of their can be realized. Although it takes time to reach full potential, these effects will provide long term benefits, and should require little maintenance. Some benefits which should occur from flood plain construction include: increasing or creating bank cover which is an important habitat component for both juvenile and adult salmonids; providing an area for deposition of fines outside the river channel, (while in the main channel, fines degrade both winter rearing and spawning habitat), establishing riparian vegetation which will provide shade over the river, and future potential debris. There is potential to maintain particular side channels as off-channel sediment traps. Some of these channels had small pools excavated which will gradually fill with sediment. This sediment could be removed by excavation equipment or, preferably, some type of suction device.

Off-channel rearing habitat such as side channels and connected dredge ponds, have many potential benefits. Off-channel rearing habitats constructed in the past have been observed rearing high densities of juvenile salmonids. Although these habitats have documented high summer usage, more information is needed to confirm winter use. A stream survey will be conducted by the U.S.F.S. during 1990 to evaluate summer and winter salmonid usage of dredge ponds connected to Crooked River. There have been confirmed observations of adult steolhead trout spawning in side channels excavated during the B.P.A. project. Although these channels were not constructed with adult spawning as an objective, it is a beneficial side effect. The extent of utilization in these channels for spawning is not clearly known at this time.

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SOUTH FORK CLEARWATER RIVER HABITAT ENHANCEMENT PROJECT:

RED RIVER

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ABSTRACT

This report describes the work carried out at Red River during the 7th year of the USFS-BPA South Fork Clearwater River Habitat Enhancement Project. The Red River segment of the project is a joint effort to rehabilitate a prime chinook salmon spawning stream damaged by mining, grazing and road construction. The habitat improvement program supports Idaho Fish and Game's efforts to reestablish chinook and steelhead populations in the North Fork and Main Red River drainages.

Improvements made to date have been primarily oriented at creating pools and holding water by placing boulders, woody debris and log and rock weirs: stabilizing eroding streambanks; and constructing side channels as supplementary rearing areas. Associated activities, funded by USFS cost-share monies, have been aimed at reducing the load of sand-sized sediment by constructing sediment traps; improving habitat in South Fork Red River and tributaries of North Fork Red River, especially where the streams have been affected by roads and recreational activities in riparian areas; and revegetating harvested areas of the North Fork and South Fork Red River floodplains.

1989 project activities were limited to planting riparian shrubs and trees on the bank stabilization structures and side channels constructed in 1988, and maintaining, and in some cases, reconstructing existing structures. With the assistance of a consulting hydrologist, plans for the channel rehabilitation work on Red River Ranch (reach III), scheduled for 1990, were refined.

Introduction

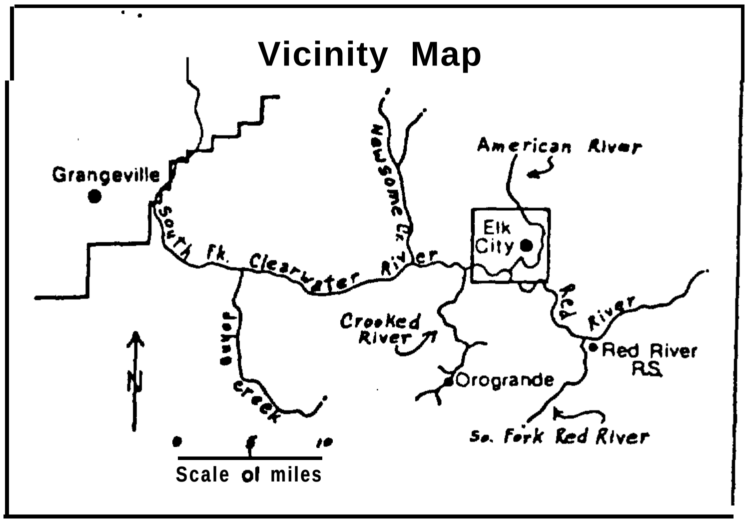
The BPA-Nez Perce South Fork Clearwater River Habitat Enhancement Project has been placed in a regional and historical context in the introduction to the Crooked River project area report (page above). The project supports Idaho Fish and Game's efforts (part of the Columbia River Fisheries Development Program) to restore viable populations of spring chinook and summer steelhead to the Clearwater River system.

Idaho Fish and Game's installations - a chinook fry rearing pond and two hatching channels located at the Red River Ranger Station - have resulted in an increase in chinook and steelhead populations in Red River. Fish and Game surveys indicate that the number of redds on Red River increased substantially after 1981, when fish released from the rearing pond first began to return (Linland and Bowler, 1986, Idaho Fish and Game Annual Project Report for the Clearwater River Development of Spring Chinook and Steelhead Stocks, Columbia River Fisheries Development Program). In 1989, after several years of drought and low flows, 75 redds were counted on Red River, a much higher number than on any other Clearwater River tributary. No steelhead eggs were planted in the hatching channels in 1989.

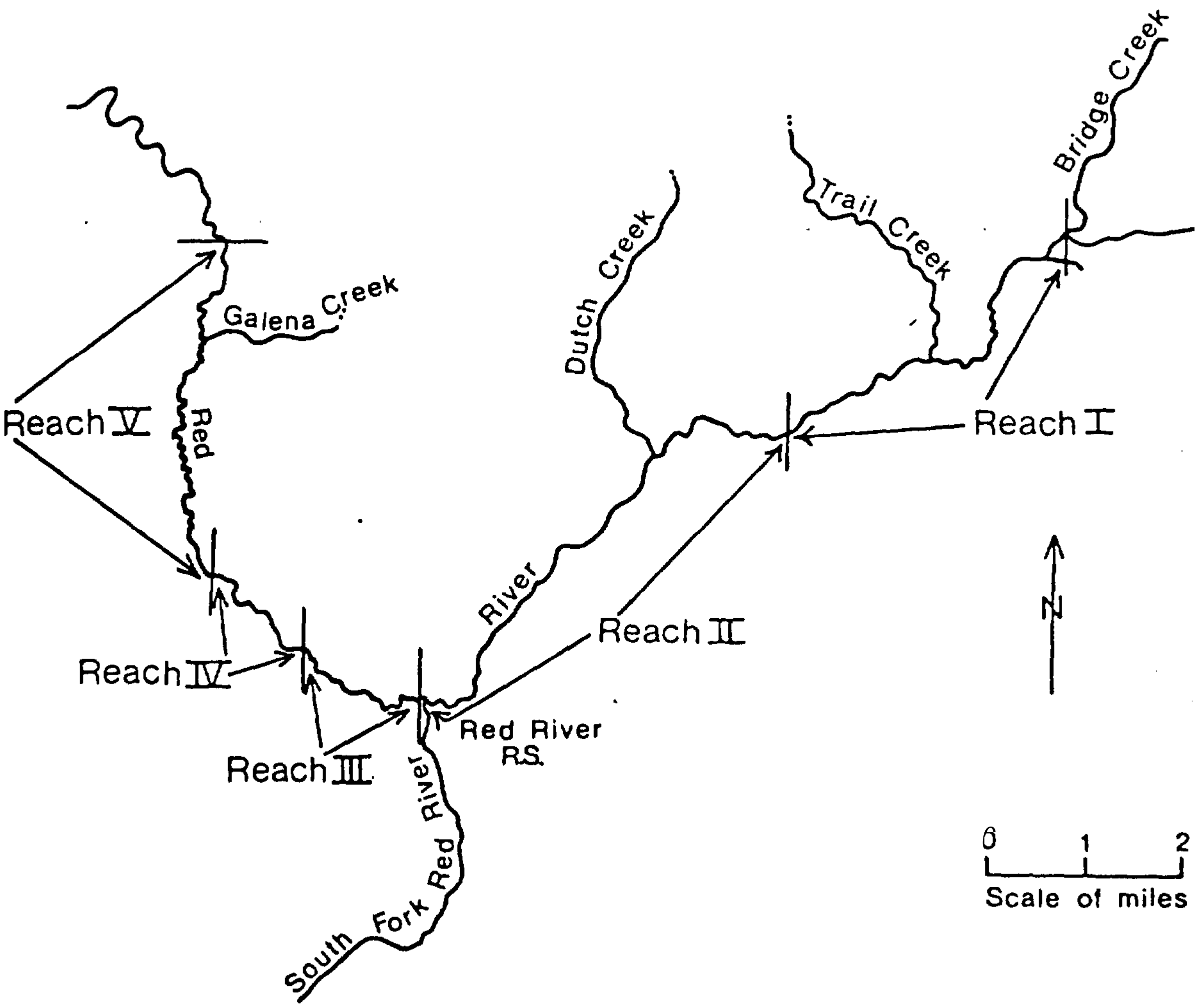
To support the reestablishment of self-sustaining anadromous fish populations, the Red River portion of the BPA-Nez Perce project is aimed at increasing habitat diversity and rehabilitating critical habitat components damaged by dredge mining, road construction, riparian grazing and timber harvest. Habitat factors that are believed to limit fish survival in Red River are: 1) a lack of pools and holding areas and, 2) a lack of juvenile rearing - particularly overwintering - areas. The lack of pools is attributable to channel Straightening and homogenization by dredge mining and to a scarcity of large woody debris due to timber harvest and road construction in riparian areas. Accelerated streambank erosion, due to mining impacts, riparian grazing and removal of streamside shrubs by ranchers, has reduced the amount of overhanging bank cover, which is needed by both adults and juveniles. Cobble embeddedness in Red River is considered to be very high, presumably due to high natural embeddedness as well as the deposition of sand-sized sediments produced by roading and other land management activities. This is believed to have reduced the inter-gravel and -cobble space available to overwintering juvenile salmonids, and has usually been considered the most significant habitat limitation.

Red River's project activities since 1983 have been directed at reconstructing and revegetating channel and bank segments damaged by mining and grazing, and at increasing the abundance of holding areas and rearing habitat by creating pools and side channels and by placing woody debris and boulders. Early project work focused on boulder and instream cover structure placements in reach IV (see attached vicinity map, Figure 1). Over 75 pool-creating structures (log and rock weirs, K-dams, deflectors) have been installed in reach II (1984-1986). Both of these reaches are on National Forest lands. Projects planned for private lands were hindered by legal problems associated with acquiring riparian easements and providing for long-term maintenance of

Red River Fish Habitat Improvement Project



● Elk City



riparian fencing. In 1988, however, ten bank stabilization/overhead cover structures and five side channels for overwintering and rearing habitat were constructed on private land in reaches I and III, under informal agreements with the cooperating landowners (see attached work statements, Appendix A).

Because of the near 100% turnover in the Red River District's fisheries and watershed staff in 1989, the District focused on maintainance of structures constructed in previous years, on orienting new staff to the project and on planning for project completion in 1990. Streambanks disturbed by the construction of side channels and bank stabilization structures on Main Red River and North Fork Red River were planted with riparian shrubs. Three 1988 structures and one K-dam built in 1986, which failed during spring high flows, were reconstructed. Channel slope and representative cross sections in reaches III and V were surveyed to assist in developing stable hydraulic designs for channel rehabilitation, and a consulting hydrologist was contracted to assist in developing those designs. To protect two newly constructed and revegetated side channels on private property in reach III, the grazing rights to the ranch were leased jointly by Idaho Fish and Game and USFS/BPA.

In conjunction with the joint BPA-Nez Perce project, Forest Service cost-share and other funds were expended from 1985 through 1989 to construct habitat improvements (pools, instream cover and bank cover structures) in South Fork Red River, and to revegetate harvested areas of its floodplain. In 1988 and 1989, five sediment traps were constructed on Red River tributaries in an effort to decrease the amount of sand-sized sediment reaching anadromous fish rearing areas. One of these was on private land, the use of which was freely donated by the landowner. The district's 1989 habitat improvements, which were put in on North Fork Red River tributaries (especially Bridge Ck), were partly funded by cost-share monies. Areas of the North Fork Red River floodplain that had been harvested were also replanted with conifers and shrubs for both shade and bank cover and stabilization. In addition, watershed erosion and sediment control projects are on-going, with the objective of decreasing the amount of suspended sediment that can blanket spawning gravels and suffocate eggs.

Description of Project Area

The project area extends from the 1800 road bridge over Red River at Gold Point to the headwaters of North Fork Red River in the vicinity of road 1166, east of Red River Hot Springs. It includes about 19 miles of mainstem stream channel, about half of which flows through privately owned land. In most cases, it is the low-gradient, meandering reaches that are in private hands: these areas are meadowlands and most are moderately to heavily grazed.

Reach V, the meadow just above Gold Point (see attached map), is currently hayed and grazed. Two sections of this very sinuous reach were straightened and widened when they were mined. The upper section (the Gibler Ranch, Figure 2) stands out in particular because it is perfectly straight, and therefore has a higher gradient than the unmined, meandering reach downstream. The transition between the mined and unmined reaches is extremely abrupt and high-velocity flow entering the series of curves downstream of the straightened reach is causing massive bank erosion.

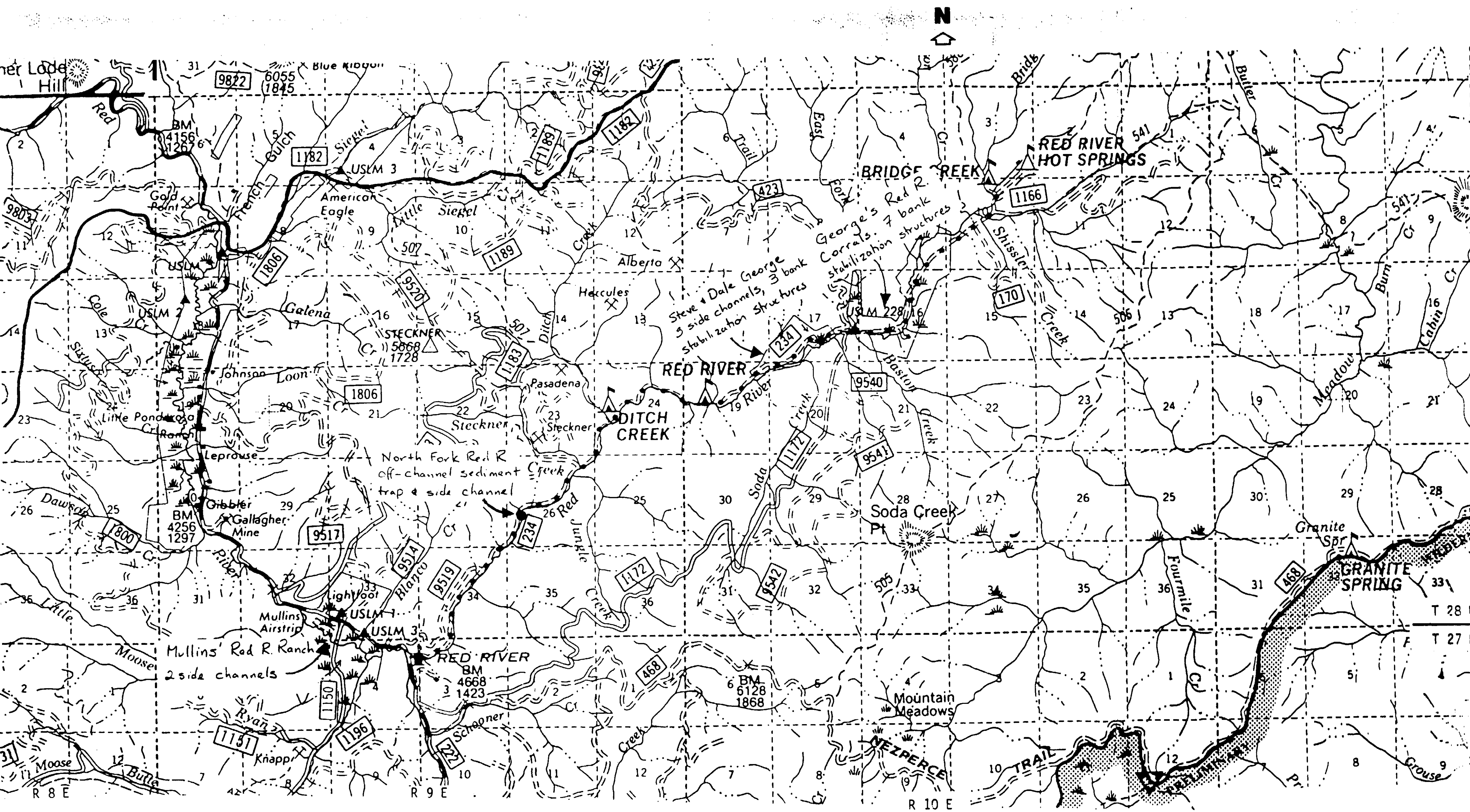


Figure 2. Location Mao for 1988 habitat imorovement structures and 1989 riparian plantings

The reach between the two meadows below the Ranger Station - reach IV - was significantly altered by dredge mining. *Many* habitat improvements have been installed in this segment of the river (see 1983 Project Annual Report). However, fine floodplain materials, which were piled on the left bank when this reach was mined, are still subject to significant undercutting where streamflow impinges on the piles.

Reach III, the meadow immediately downstream of the Ranger Station, is currently leased for horse grazing. Essentially no riparian shrubby vegetation remains, the stream is completely exposed, and accelerated bank erosion is occurring. Two side channels were constructed in this reach (Mullins' Red River Ranch) in 1988.

Above the Ranger Station, about half of the riparian acreage of reach II was harvested by group selection cut in 1982. This reach is also included in the Red River grazing allotment, which has a stocking level of 70 cow-calf pairs. Active attempts are being made to limit grazing activity to upland sites within this allotment. At least 78 pool-creating structures have been constructed (1985-1987) in this reach because the pool:riffle ratio was determined to be undesirably low. Timber harvest and the presence of the Hot Springs Road (road 234) have left this reach with insufficient numbers of either active or potential debris. Some bank erosion is also occurring.

Reach 1, upstream of Red River Campground, flows mostly through privately owned meadows. Upstream of Otterson Ck, however, it is on Forest land. Parts of this segment, especially on the private lands, are heavily grazed and subject to severe bank erosion. District personnel estimated that bank erosion in the Red River Corrals area contributed on the order of 200 tons of sediment per year to the stream before stabilization structures were constructed in 1988. Upstream, where the riparian area is not grazed by stock, the channel is much narrower and deeper, and overhangs are frequent and extend far back under the banks. With the possible exception of its sediment load, the stream appears to be in near-pristine condition.

Methods and Materials

1989 Riparian Planting

Locations of the side channels and bank stabilization structures constructed in 1988 are shown on the attached map. Objectives of planting riparian vegetation on these structures were to provide bank cover and shade and, more importantly, to encourage the growth of deep-rooted woody vegetation that, over time, will stabilize the log structures and streambanks. Over 600 riparian shrubs and trees were hand-planted on seven fenced bank stabilization/overhead cover structures at Archie and Eileen George's Red River Corrals (reach I). Approximately 400 native willow slips (Salix spp., about 15" to 20" long) were planted close to the water's edge at a 2' spacing: alder (Alnus tenuifolia), elderberry (Sambucus cerulea), red osier dogwood (Cornus stolonifera), quaking aspen (Populus tremuloides), and green ash (Fraxinus pennsylvanica) were also planted. Green ash is not a native species and has not been planted before at Red River; it is experimental.

About 1400 plants were set out on the 3 side channels and 5 bank stabilization structures on Dale and Steve George's property, the downstream segment of reach I. Native willow cuttings were placed near the water's edge at 2'-4' intervals, and 120-140 each of red osier dogwood, mountain or sitka alder and blue elderberry were planted within a distance of about 15' from the water's edge. No aspen were planted here or in reach III: previous aspen plantings in valley bottoms have had poor success and District staff felt survival in these locations would be minimal.

The two side channels on the Mullins property in reach III, with a total bank length of approximately 3600', were planted with 160 plugs of native Carex dug from nearby, 1800 native willow cuttings, 90 elderberry plants and a few experimental bullrush (Scirpus spp.) plants. All of the planting work was accomplished in April and May 1989.

Planting stock was ordered from Reggaer Tree Farms in Orofino, Idaho (4' aspen with rootballs), Cliftyview Nursery in Bonner's Ferry, Idaho (1-0 bareroot stock) and Bitteroot Native Growers in Hamilton, Montana (1-0 containerized stock). 1-0 stock were stored at 31 degrees F in a refrigerated storeroom and were planted within 1 month of delivery--within 2 weeks in most cases. Trees were stored outside in partial shade and were kept moist (handwatered) until planting.

Structure Maintenance

An inventory of the existing structures was done in the spring and several were identified as needing either maintenance or major reconstruction. Structure maintenance was carried out by hand; a backhoe was contracted to assist with reconstruction. Equipment and materials similar to those used in the original construction were utilized; ie., logs felled on-site, a Hilty drill, Stihl chain saws, 3/8" rebar and riprap hauled from a USFS quarry on road 1172 (the Soda Creek road). Where necessary, however, filter cloth was replaced with more durable vexar screening; treated lumber and larger volumes of rock were used to reconstruct and/or stabilize failed structures.

Results and Discussion

As mentioned earlier, because of the recent staff turnover and the need to orient new people to the project, 1989 field work was limited to revegetating areas disturbed by the 1988 construction activities, and to reconstructing several structures. The reconstruction work is described below.

One log weir constructed in 1986 in reach II, near the mouth of Jungle Creek, was found to have caused flow to route around the structure, resulting in a significant amount of bank erosion, About 6 cubic yards of riprap were placed to stabilize the bank and a large rootwad was anchored in the downstream plungepool to provide cover. Two of the log weirs constructed at Archie George's in 1988 had also failed. In both cases, the filter cloth backing had torn. One weir had been placed in a site with very low banks, which permitted water to flow around the log and erode the adjacent floodplain materials. Because the site was considered to be unsuitable, this structure was removed, the banks were shaped and the area was reseeded. The second weir had been placed at a slight angle to the flow and, during high flow, directed water into a 3'-high bank. Although a revetment had been constructed to protect the bank, it had been undermined and several cubic yards of soil were eroded from behind it. Riprap was placed in this area, covered with topsoil and reseeded. The failed filter cloth was also replaced with 1/4" vexar screen.

In 1988, a side channel was constructed at the site of the existing off-channel sediment trap in reach II. A culvert functioned as the inlet control structure for the side channel. This culvert was so efficient at taking in sediment that the small sediment basin behind it, as well as the bed of the side channel itself, were buried in sand (see photo 1). After high flow, only a few inches of headspace were left in the 24" culvert, the rest having filled with sand. About 14 cubic yards of sand were removed from the sediment basin, and the culvert was replaced with a treated-lumber dam-board structure so that the height of the intake and the volume of flow can be manipulated (see photo 2). At times, the new side channel appeared to be backwatering the sediment trap, stopping water from flowing through the trap. The new dam-board structure should not only reduce the amount of sediment flowing into the side channel, but will also permit regulation of the water level in the channel. Seven rock wiers and two boulder clusters were installed in the side channel this year to provide additional habitat diversity for juvenile rearing.

With the support of the BPA project coordinator (Rick Stowell), the District was able to complete a one-season lease agreement with Mrs. Edith Mullins (reach III) to protect the newly constructed side channels and riparian plantings on her land from grazing pressure, In a cooperative venture with Idaho Fish and Game and Red River's trails program, grazing rights to the Red River Ranch were rented and District stock were excluded from the streamside pastures.

Monitoring

The potential for anchor ice is a concern that has been raised about the viability of the side channels as overwintering habitat. Several casual observations in January and February 1989 indicated that although there was a complete ice cover over the upper Mullins side channel, the channel was not frozen solid. The District plans to repeat these observations this winter and results will be included in the final project report.

Several flow measurements were taken in the side channels in 1989. In mid-May, a flow of 1.1 cfs was measured in the upper Mullins side channel, with very slow velocities of 0.4 fps and 0.07 fps at two cross sections. Very few fish were observed in this channel throughout the summer. In contrast, the lower side channel on the Mullins property was flowing at 9-11 cfs in mid-May, dropping to about 3 cfs in early July. Measured average velocities varied from 0.6 fps at low flow to 2.4 fps. This channel was observed to be crowded with juvenile salmonids during the summer of 1989.

Photo 1. North Fork Red River side channel inlet showing culvert (below rock) and sediment basin with sand accumulation. June 1989

Photo 2.

North Fork Red River side channel inlet after construction of dam-board inlet control structure. September 1989

Summary and Conclusions

The several structures that malfunctioned this year indicated a need for more careful site analysis and hydraulic design. To ensure that future structures will function over a wide range of flows, the project is increasing its use of expertise in hydraulics and hydrology. To assist the project in addressing the channel rehabilitation needs in the lower meadow reaches (III and V), Dave Rosgen, a consulting hydrologist, was contracted for a l-day walk-through survey. In place of the weir structures envisioned in the original project agreement, he recommended bank stabilization structures constructed with tree boles and whole rootfans. These will not only stabilize cutbanks on the outsides of meander bends, but will also promote natural scour when the rootfans intercept the thalweg, enhancing the pool:riffle ratio in these dredge-mined reaches. Where the river is over-wide, he recommended installation of deflectors high enough to create a meandering low-flow thalweg but low enough to pass high flows without endangering the banks. In many parts of the meadow reaches of the river, the floodplain is low for some distance from the streambank on at least one side and weir structures would only spread the river out further. It is doubtful that the localized benefit of the structures' plungepools would offset this. The structures recommended by Rosgen will help to recreate the characteristics of the natural channel and are expected to produce much greater benefits than those originally planned. Structure design specifications will be developed using the channel survey data collected in fall 1988.

During the walk-through survey, we were accompanied by Bert Bowler of Idaho Fish and Game, and by two of the riparian landowners. Rosgen participated in discussions with the landowners, describing and explaining his ideas. Their reactions were very positive and Edith Mullins, in particular, is enthusiastic about the District's plans to implement the enhancement work on her property in 1990. She is willing to have a fence built to protect the riparian area, as long as controlled access to water is provided for stock. The Giblers (at the upstream end of reach V) are also enthusiastic: however, it will not be possible to rehabilitate the drastically disturbed channel on their property without additional time and funding. The additional time needed to reconstruct the channel in the lower meadow (reach V) is 4 years, and the cost is estimated at about $200,000. Project staff will need to keep the landowners up-to-date on project plans and progress if we are not to lose the momentum generated by discussions during Rosgen's visit.

APPENDIXA

1988 WORK PLANS FOR HABITAT ENHANCEMENT PROJECTS ON PRIVATE LANDS

WORK STATEMENT

South Fork Clearwater River Tributary Enhancement:
Red River, Eileen and Archie George's Red River Corrals

Administrative Summary:

Job Leaders: Cole Cracker-Bedford and Russ Poehner

Job Area: Archie and Eileen George's Red River Corrals

Job Period: July 1, 1988 to August 15,1988

Project Period: July 1, 1988 to March 31,1990

Project Headquarters: U.S. Forest Service
Red River Ranger Station
P.O. BOX 23
Elk City, Idaho 83525

This job is a portion of the BPA project for the Red River watershed which is under the leadership of Rick Stowell, supervisor's office Nez Perce National Forest. This job is covered under the Environmental Assessment for the Red River Fish Habitat Management Plan.

CURRENT SITUATION

The principle objectives of this project are to reduce the amount of source erosion contributed by unstable cut-banks, establish riparian vegetation, and to enhance overwintering habitat through cover structure installations.

The detrimental effects of sedimentation are well documented in numerous studies. These studies indicate the following: 1) Sedimentation compacts spawning gravels, reducing the adult's preference for such sites. 2) It fills interstitial spaces between rocks, thereby limiting aerated water flow to incubating eggs and reducing the removal of metabolic wastes. 3) Sediment forms a barrier to fry emergence by blocking the route of regress. 4) Sediment fills the interstitial overwintering habitat of juvenile salmonids. 5) The production of aquatic organisms is reduced as the substrate is filled and covered with sediment, thus reducing the overall food supply.

Analytical suspended sediment and stream core sampling was not initiated until recently. Therefore, it is difficult to determine what the baseline sediment load was prior to resource development. Aerial photo interpretation, combined with ground measurements, indicates that the average annual rate of erosion is at least 200 tons for the reach of Red River flowing through the project area. Bank instability and failure are the primary sources of erosion throughout the analysis area.

Well vegetated banks are usually stable regardless of bank undercutting, providing excellent cover. Valuable fish cover is ultimately lost when bank vegetation decreases, when banks erode too severely, or when banks undercut too quickly and slough off into the stream bottom. Certain land uses, especially wildlife and livestock grazing, can accelerate the degradationn of a stream by causing instability of the banks.

A common hydraulic characteristic indicating bank instability can be noted throughout the project. Characteristically, the inside of the bend,(point bar), is a zone of sediment deposition; and the outside of the bar is a zone of instability and accelerated bank erosion. The result is an asymmetrical cross section as shown in figure la. Under normal circumstances the surface of an undercut bank is stabilized by vegetation even as the current undermines the outside bank. Throughout the project area, however, vegetational support has been reduced, subsequently allowing the current to destabilize the slope, collapsing the overhanging-undercut bank.

Note that bank instability is most commonly associated with the outside of bends in the channel, but is not restricted to bends. It can and commonly does occur on straight channel reaches throughout the project area. Sometimes, the destabilized bank only partially collapses, creating a stairstep appearance at the bottom of the bank as shown on Photo page #2, site #4.

LOCATION AND CHARACTERISTICS

The reach is located in Red River Corrals Ranch near Forest Service Rd #234.(see figure 2) The stream is a meandering, meadow-type with shallow gradient. The banks should naturally be undercut, providing cover and holding water. Currently many banks are sluffing off at unnaturally high rates and have little or no overhanging cover. The total length of the reach is 6,100 ft.

There are seven sites targeted for bank stabilization and revegetation projects.(see aerial photo #1 & #2) These seven sites combined give a total disturbed area of 2,870 sq.ft.. Within this area it is estimated that at least 70 tons of soil is lost per year because of bank erosion.

Site 1. Located west of the bridge. The bank to be reshaped has a north facing aspect. The site is 164 ft long with a total disturbed area of '701 sq. ft.. Presently the bank has a 129% slope. Soil is being lost at an estimated annual rate of 24 tons (24 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page #1)

Site 2. Located east of bridge, behind the barn. All remaining sites are east of the bridge. The bank to be reshaped has a south facing aspect. The site is 115 ft. long with a total disturbed area of 344 sq. ft.. Presently the bank has a 92% slope. Soil is being lost at an estimated annual rate of 4 tons (4 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page #1)

Site 3. The bank to be reshaped has a west facing aspect. The site is 92 ft. long with a total disturbed area of 336 sq. ft.. Presently the bank has a 90% slope. Soil is being lost at an estimated annual rate of 11 tons (11 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page #2)

Site 4. The bank to be reshaped has a northwest facing aspect. The site is 75 ft. long with a total disturbed area of 202 sq. ft.. Presently the bank has a 96% slope. Soil is being lost at a estimated annual rate of 3 tons (3 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page #2)

Site 5. The bank to be reshaped has a west facing aspect. The site is 148 ft. long with a disturbed are of 598 sq. ft.. Presently the bank has a 86% slope. Soil is being lost at an estimated annual rate of 7 tons (7 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page #3)

Site 6. The bank to be reshaped has a east facing aspect. The site is 120 ft. long with a total disturbed area of 301 sq. ft.. Presently the bank has a 95% slope. Soil is being lost at an estimated annual rate of 12 tons (12 cu. yds.) per year. There is no overhanging bank cover or vegetational cover.

Site 7. The bank to be reshaped has a west facing aspect. The site is 88 ft. long with a total disturbed area of 357 sq. ft. Presently the bank has a 102% slope. Soil is being lost at an estimated annual rate of 10 tons (10 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. The site also contains an animal crossing.

TECHNIQUES FOR IMPROVEMENTS

Bank sill with cover log: This structure is used to protect unstable banks, at the same time providing excellent overhead cover for fish. The design is a simple sill with anchor logs extending as far back into the bank as necessary to assure structure stability (4 to 6 feet in stable soils and 10 feet or more in unstable soils). The lower anchor logs should be near water level and should extend 18 to 24 inches from the bank. The cover log can then be pinned with 1/2" rebar to the sill log and the lower anchor (figure 3).The structure can be from one to several logs high, depending upon bank height. This design accomplishes two objectives. It enhances bank stability and creates excellent cover at the same time.

Lattice log structure: This structure is used to protect the renovated slope and the vegetation planted on the slope. The design uses logs approximately 33' long with a diameter of 8 - 12", placed in rows parallel to the stream and slightly sunken into the ground. Short perpendicular logs will be placed on top of the bottom logs. The placement of logs begins at the streams edge and continues up the slope till a point of undisturbed soil. The first two or three logs at the top of the slope will be placed fairly close together. Spacing of logs will increase in the middle section of the slope, The stucture will be tapered towards the stream on the edges. The logs will be held in place with wooden stakes, 4-6" diameter. Four stakes will be used on the downhill edge of the log and 2 on the uphill edge. These stakes will be attached to the lattice logs by countersunk lags.(See Figure 3).

Slope stabilization: This is accomplished by reducing the present slope to a 30-40% slope. The slope is begun by pushing some of the soil from the shear banks down onto the cover structure, then working the remainder of the soil back to create the gentler slope. The shaping of the slope will incorporate the natural contour of the surrounding ground. After shaping of the slope is completed and the lattice structure set in place, sod forming grasses and forbes will be seeded and curlex matting layed. Later, in the fall or spring, riparian shrubs will be planted.

CONTRACTS:

Contracts were written for operations involving machine log hauling, log hauling by a horse team and heavy equipment use. Log hauling will involve hauling logs from U.S. Forest Service lands to designated sites at the project area. (Refer to Appendix I for number of logs to be moved).

Log hauling by horse team will involve moving specified numbers of logs. (Refer to Appendix I for number of logs for each individual site.) Hours of work for this contract will be determined by the number of logs to be moved and the distance of the moves.

Heavy equipment will consist of a track mounted excavator. It will begin work by approximately July 11, 1988 and work will be completed before August 15, 1988. The work schedule will be Monday thru Friday, with occasional six day weeks during portions of the project. Work will start at 6:30 and end each day at 17:00 hrs. Work will be done from the stream bed, with changes in work sites also being made in the stream bed, High emphasis will be placed on minimizing the disturbance of meadows,

END PRODUCT DESCRIPTION

Upon completion of the project there will be four major types of change: log cover structure placements, angle of slope reduction, log lattice structure installations and riparian vegetation enhancement.

The log cover structures, were designed to provide both initial areas of overhanging cover and natural developement of undercut areas. These undercut areas, however, will not adversely effect bank stability. Upon completion these structures will create an estimated 2,696 sq. ft. of overhead cover throughout the entire project area. The log cover structures will also reduce bank erosion,

To establish vegetation, the slopes will be reduced to 30-40%, approximating stable conditions. Shaping of the bank will be done in such a manner as to create a natural contour with the surrounding terrain. Log cover structures will act as sills providing additional support to the reduced slopes.

Log lattice structures will be anchored to the reduced slope and slightly sunken, approximately 20% of the diameter of the log. This lattice is designed to provide additional stability for the slope and protection of vegetation. Initially this structure will be two logs high, but as the vegetation grows it is foreseeable that an additional log tier will be added to continue the protection of the growing vegetation. The completed structures will cover approximately 4,461 sq. ft.. After the lattice structures have been completed the area will be revegetated. The increased vegetation on the reduced slopes will provide added stabilization to the banks. As with the log lattice this vegetation will *cover* a total project area approximating 4,461 sq. ft. The revegetation will consist of a mix of sod forming grasses, forbs and riparian shrubs. The exact species mix will be agreed upon by the George's (a tentative list of species can be found in Appendix 2). Shrubs will be planted in the fall or spring, while the grasses will be seeded concurrently with the construction. Though grass seeding will be concurrent with the construction, some erosion of the slopes may occur. The extent of which is dependent upon how quickly the vegetation becomes established. (See figure lb)

The discussion so far has been limited to a description of the end products realized immediately *or* within one year of completion of the project. Over an extended period of time other changes will occur. For example, after approximately 20 years the cover structure will have begun to decay. By this time the banks should have become stable enough to be unaffected by the loss of the logs. Within 20 years the lattice structure will also have decayed and the vegetation will have become well established, As the amount of vegetation increases and grows it will progressively decrease the amount of sediment reaching the stream . This then means that over time the slopes themselves will retain their 30-40% slope.

NET BENEFITS

The benefits of this project can be classified under the areas of sediment reduction and increased habitat. Sediment entering the stream will be reduced in two ways. Some reduction will be due to the increased vegetation which holds the soil on the slopes from being washed down to the stream. The major reduction of sediment, however, will occur because of the decrease of large amounts of soil from the banks breaking off into the stream. It has been determined, by aerial photo comparisons, that annually at least 70 tons of soil has eroded off the banks of the project sites. Erosion should be greatly reduced at the project sites.

Increased habitat is the other area of benefits for this project. These benefits occur in several forms. One form is the overhanging banks, which create cover. It is estimated that 2,696 sq. ft. of overhanging bank cover will be created from this project. When the vegetation planted on the banks has become established, there will be an increased amount of shading to the stream. The new vegetation will also provide deciduous matter to the stream, contributing to the increase in primary macroinvertebrate production.

APPENDIX I: MATERIALS

SITE #	1	2	3	4	5	6	7	ACTUAL TOTAL	AMTS. ORDERED
# LATTICE LOGS (33' @ 8-12" DIA.)	50	38	28	24	46	24	32	242	260
# ANCHOR LOGS (10-12' @ 6-8" DIA.)	80	64	64	48	80	64	48	448	500
# SILLS LOGS (33' @ 14-16" DIA.)	18	14	12	8	16	14	11	93	100
# STAKES (6' @ 4-6" DIA.)	160	128	88	80	144	96	104	800	820
# REBAR (1/2" x 20")	338	276	276	207	345	280	207	1929	1950
CURLEX (4' X 300')	-	-	-	-	-	-	-	3 ROLLS	3 ROLLS
LAGS (10")	160	128	88	80	144	96	104	800	820
LAGS (16")	160	128	112	80	160	96	96	832	850

APPENDIX II:
Plants which may be used for riparian revegetation

Conifers
- Ponderosa Pine
- Douglas Fir
- Engelmann Spruce
- Subalpine Fir
- Lodgepole Pine

Deciduous trees & shrubs
- *Salix* spp. (native willow cuttings)
- *S. scouleriana* - scouler willow, mountain willow
- *P. tremuloides* - quaking aspen

Symphorocarpus sp. - snowberry

Cornus stolonifera - redosier dogwood

Crataegus douglasii - douglas hawthorn, black hawthorn

Alnus sinuata - sitka alder
A. tenuifolia - thin leaf alder
A. incana - mountain alder

Acer glabrum - Rocky Mountain Maple

Betula papyrifera - paper birch
B. occidentalis - water birch

Prunus virginiana - chokeberry

Rosa sp. - rose
Sambucus cerula - blue elderberry

Grasses
- Annual Ryegrass
- Pubescent Wheatgrass
- Streambank Wheatgrass
- Intermediate Wheatgrass
- Timothy
- Reed Canarygrass
- Meadow foxtail
- Hard fescue
- Kentucky bluegrass

Legumes
- White clover
- Alsike clover
- Yellow sweet clover
- Cicer Milkvetch
- Alfalfa

WORK STATEMENT

South Fork Clearwater River Tributary Enhancement:
Red River; Dale and Sharon, Steve and Mary George's Ranch

July 12, 1988

Administrative Summary:

Job Leaders: Cole Cracker-Bedford and Russ Poehner

Job Area: Dale and Steve George's Ranch

Job Period: July 1, 1988 to August 15,1988

Project Period: July 1, 1988 to March 31,1990

Project Headquarters: U.S. Forest Service
Red River Ranger Station
P.O. BOX 23
Elk City, Idaho 83525

This job is a portion of the BPA project for the Red River watershed which is under the leadership of Rick Stowell, Supervisor's Office Nez Perce National Forest. This job is covered under the Environmental Assessment for the Red River Fish Habitat Management Plan.

CURRENT SITUATION

The principle objectives of this project are to reduce the amount of source erosion contributed by unstable cut-banks, establish riparian vegetation, and to enhance overwintering habitat through cover structure and side-channel installations.

The detrimental effects of sedimentation are well documented in numerous studies. These studies indicate the following: 1) Sedimentation compacts spawning gravels, reducing the adult's preference for such sites. 2) It fills interstitial spaces between rocks, thereby limiting aerated water flow to incubating eggs and reducing the removal of metabolic wastes. 3) Sediment forms a barrier to fry emergence by blocking the route of regress. 4) Sediment fills the interstitial overwintering habitat of juvenile salmonids. 5) The production of aquatic organisms is reduced as the substrate is filled and covered with sediment, thus reducing the overall food supply.

Analytical suspended sediment and stream core sampling was not initiated until recently. Therefore, it is difficult to determine what the baseline sediment load was prior to resource development. Aerial photo interpretation, combined with ground measurements, indicates that the average annual rate of erosion is at least 104 tons for the reach of Red River flowing through the project area. Bank instability and failure are the primary sources of erosion throughout the analysis area.

Well vegetated banks are usually stable regardless of bank undercutting, providing excellent cover. Valuable fish cover is ultimately lost when bank vegetation decreases, when banks erode too severely, or when banks undercut too quickly and slough off into the stream bottom. Certain land uses, especially wildlife and livestock grazing, can accelerate the degradation of a stream by causing instability of the banks.

A common hydraulic characteristic indicating bank instability can be noted throughout the project area, Characteristically, the inside of the bend is a zone of sediment deposition and is known as a point bar. As sediment is deposited on the point bar, the bar is enlarged and thus restricts the cross sectional area of the stream channel. The river channel adjusts by moving laterally, causing bank erosion and undercutting on the side opposite the point bar. The result is an asymmetrical cross section as shown in figure la. This physical process is natural, and under normal circumstances, the surface of an undercut bank is stabilized by vegetation even as the streamflow undermines the outside bank. Throughout the project area, however, the process of bank erosion and lateral migration of the stream channel has been increased dramatically because an increased sediment supply and wildlife and livestock grazing.

Note that bank instability is most commonly associated with the outside of bends in the channel, but is not restricted to bends. It can and commonly does occur on straight channel reaches throughout the project area where sediment deposition causes restriction of the channel. Sometimes the destabilized bank only partially collapses, creating a stair-step appearance at the bottom of the bank as shown on Photo page #3, site #4.

Another aspect of this project site under consideration is that of side-channels. Side-channels are areas of relatively low, constant water velocity. These areas of low velocity, if they're at least 0.2 m deep, are useful as spawning habitat and are especially good as winter rearing habitat for salmonids. Because the project site has no side-channels, the lack of good wintering habitat causes junvenile fish to seek shelter in less desirable locations where they are more susceptible to predation by larger fish.

LOCATION AND CHARATERISTICS

The reach is located along Forest Service Rd #234 on the H.E.S. 736; T.28 N., R.10 E., Sec. 17,18,19, 20. (see figure 2) The stream is a meandering, meadow-type with shallow gradient. The banks should naturally be undercut, providing cover and holding water. Currently many banks are eroding away at unnaturally high rates and have little or no overhanging cover. The total length of the reach is 9,300 ft.

There are five sites targeted for bank stabilization and revegetation projects (see aerial photo #1 & #2). These five sites combined give a total disturbed area of 1,477 sq. ft.. Within this area it is estimated that at least 15 cubic yards of soil is lost per year because of bank erosion.

Site 1. Located 273 ft. from the northeastern property boundary. The bank to be reshaped has an east facing aspect. The site is 73.8 ft. long with a total disturbed area of 186.7 sq. ft.. Presently the bank has a 168% slope. Soil is being lost at an estimated annual rate of 1.4 cubic yards. There is no overhanging bank cover or vegetational cover. Portions of the bank which have failed have remained intact near the existing bank. (see photo page 1)

SITE 2. Located 583 ft. from the northeastern property boundary. The bank to be reshaped has an northwest facing aspect. The site is 57.1 ft. long with a total disturbed area of 166.1 sq. ft.. Presently the bank has a 198% slope. Soil is being lost at an estimated annual rate of 1 cubic yard. There is no overhanging bank cover or vegetational cover. A large lodge pole pine exists at the bank edge at the end of the disturbed area. Portions of the bank which have failed have remained intact near the existing bank. (see photo page 1)

3ITE Located 1,312 ft. from the northeastern property boundary. The bank to be reshaped has an east facing aspect. The site is 159.7 ft. long with a total disturbed area of 453.7 sq. ft.. Presently the bank has a 180% slope. Soil is being lost at an estimated annual rate of 4.3 cubic yards. There is no overhanging bank cover or vegetational cover. (see photo page 2)

SITE 4. Located 1,932 ft. from the northeastern property boundary. The bank to be reshaped has an east facing aspect. The site is 124.6 ft. long with a total disturbed area of 445.0 sq. ft.. Presently the bank has a 148% slope. Soil is being lost at an estimated annual rate of 3.4 tons (3.4 cu. yds.) per year. There is no overhanging bank cover or vegetational cover. (see photo page 3)

5ITE Located 2,625 ft. from the northeastern property boundary. The bank to be reshaped has an south facing aspect. The site is 131.2 ft. long with a total disturbed area of 225.7 sq. ft.. Presently the bank has a 199% slope. Soil is being lost at an estimated annual rate of 5.1 cubic yards. There is no vegetational cover but there is some overhanging bank cover.(see photo page 4)

Three sites targeted for side channel development were evaluated. These sights were selected because of the ease with which they could be connected to existing overflow channels and abandoned meanders.

Side Channel 1. The project site is located on the north side of Red River approximately 1000 ft. downstream of the northeast fenceline (see aerial photo #1 and Figure 4a). The side channel will utilize an abandoned marshy, meander channel. The length of the finished channel is approximately 219 feet. It will require excavation of about 65 cubic yards of material which will be spread on site, out of wetland areas, and revegetated.

Side Channel 2. The project site is located on the south side of Red River approximately 4800 ft. downstream of the northeast fenceline (see aerial photo #3 anh Figure 4b). The side channel will utilize an abandoned meander channel. Two small streams enter into the abandoned meander channel near the lower end of the channel. The length of the finished channel will be about 410 feet. It will require excavation of about 50 cubic yards of material which will be spread on adjacent non-wetlands sites and revegetated.

Side Channel 3. The project site is located on the south side of Red River approximately 5400 ft. from the northeast fenceline (see aerial photo #3). An abandoned overflow channel will be reopened, widened, and an outlet created. The finished channel will be approximately 150 ft. long and will require excavation of about 30 cubic yards of material.

TECHNIQUES FOR IMPROVEMENTS

Bank sill with cover log: This structure is used to protect unstable banks, at the same time providing excellent overhead cover for fish. The design is a simple sill with anchor logs extending as far back into the bank as necessary to assure structure stability (4 to 6 feet in stable soils and 10 feet or more in unstable soils). The lower anchor logs should be near water level and should extend 18 to 24 inches from the bank. The cover log can then be pinned with 1/2" rebar to the sill log and the lower anchor (figure 3).The structure can be from one to several logs high, depending upon bank height. This design accomplishes two objectives. It enhances bank stability and creates excellent cover at the same time.

Lattice log structure: This structure is used to protect the renovated slope and the vegetation planted on the slope. The design uses logs approximately 33' long with a diameter of 8- 12", placed in rows parallel to the stream and slightly sunken into the ground. Short perpendicular logs will be placed on top of the lattice logs. The placement of logs begins at the streams edge and continues up the slope till a point of undisturbed soil. The first two or three logs at the top of the slope will be placed fairly close together. Spacing of logs will increase in the middle section of the slope. The structure will be tapered towards the stream on the edges. The logs will be held in place with wooden stakes, 4-6" diameter. Four stakes will be used on the downhill edge of the log and 2 on the uphill edge. These stakes will be attached to the lattice logs by countersunk lags.(See Figure 3).

Slope stabilization: This is accomplished by reducing the present slope to a 30-40% slope. The slope is begun by pushing some of the soil from the shear banks down onto the cover structure, then working the remainder of the soil back to create the gentler slope. The shaping of the slope will incorporate the natural contour of the surrounding ground. After shaping of the slope is completed and the lattice structure set in place, sod forming grasses and forbes will be seeded and curlex matting laid. Later, in the fall or spring, riparian shrubs will be planted.

Point bar excavation: About 2 to 8 cubic yards of material will be removed from the point bar opposite the bank stabilization structures to provide storage for sediment during the next runoff season. By removing a small quantity of sediment in this location and thereby reducing the stress on the opposite bank, the stabilization structures will have the opportunity to become better established.

Perennial Side Channels: These improvements where located to take advantage of natural abandoned meanders and overflow channels to minimize the amount of excavation required. Length of the channels will vary, depending on the site, the width will average three feet. Water depths will vary between 1-2 ft. The channel sides will be vertical except in the cases where the walls of the channel will be over 1.5 feet in height. In these cases the sides will be laid back to a 1:1 slope.

The channels will have a gradient of less than one percent which will allow for calm water during the entire year and yet will provide enough energy for the channel to maintain its configuration. This gradient will also prevent the erosion of a gravel/cobble substrate. Cobble sized rock can be salvaged from the excavated material and used to line, or armour, the side channel bottom. If additional rock is needed, washed rock can be transported to the site for the same purpose.

An 18" culvert will be placed at the inflow to the channel near the bottom of the thalweg, or lowest point in the channel. The culvert will be installed in such a manner as to be unobtrusive. It will be covered by rocks which will help in the prevention of erosion and excessive flow during periods of high flow.

Some sediment will be carried into the side channel, but since inlets will be located in quiet pools downstream from the deposition point or straight reaches, quantities should be minimal.

Streamflow in the side channel can be further controlled by a log drop structure in the mainstream below the inlet to the side channel and/or at the outlet of the side channel. Additional control of water depth and velocity can be accomplished within the side channel with small drop structures such as rock weirs or log sills. Habitat can be enhanced by using strategically placed root wads, loose logs, boulder berms, boulder clusters or flow deflectors.

The side channel should be "flushed" or cleaned during the first runoff period after construction to remove unwanted fine sediment and debris. To prevent this flushed material from reaching the main stream, sediment traps or settling ponds will be constructed near the outlet. Water will be diverted to this sediment trap for the first runoff season. After this first season the water course will be returned to the side channel and on to the mainstream.

CONTRACTS

Contracts were written for operations involving machine log hauling, log hauling by a horse team and heavy equipment use. Log hauling will involve hauling logs from U.S. Forest Service lands to designated sites at the project area. (Refer to Appendix I for number of logs to be moved).

Log hauling by horse team will involve moving specified numbers of logs. (Refer to Appendix I for number of logs for each individual site.) Hours of work for this contract will be determined by the number of logs to be moved and the distance of the moves.

Heavy equipment will consist of a track mounted excavator. It will begin work by approximately July 11, 1988 and work will be completed before August 15,1988. The work schedule will be Monday thru Saturday. Work will start at 5:00 and end each day at 21:00 hrs. Work will be done from the stream bed, with changes in work sites also being made in the stream bed. High emphasis will be placed on minimizing the disturbance of meadows.

END PRODUCT DESCRIPTION

Upon completion of the project there will be five major types of change: log cover structure placements, bank slope reduction, log lattice structure installations, riparian vegetation enhancement, and perennial side channel installation.

The log cover structures, were designed to provide both initial areas of overhanging cover and natural development of undercut areas. These undercut areas, however, will not adversely effect bank stability. Upon completion these structures will create an estimated 2,097 sq. ft. of overhead cover throughout the entire project area. The log cover structures will also reduce bank erosion.

To establish vegetation, the slopes will be reduced to 30-40%, approximating stable conditions. Shaping of the bank will be done in such a manner as to create a natural contour with the surrounding terrain. Log cover etructurss will act as sills providing additional support to the reduced slopes.

Log lattice structures will be anchored to the reduced slope and slightly sunken, approximately 20% of the diameter of the log. This lattice is designed to provide additional stability for the slope and protection of vegetation. Initially this structure will be two logs high, but as the vegetation grows it is foreseeable that an additional log tier will be added to continue the protection of the growing vegetation. The completed structures will cover approximately 2,654 square feet, After the lattice structures have been completed the area will be revegetated. The increased vegetation on the reduced slopes will provide added stabilization to the banks. As with the log lattice this vegetation will cover a total project area approximating 2,654 square feet. The revegetation will consist of a mix of sod forming grasses, forbs and riparian shrubs. The exact species mix will be agreed upon by the George's (a tentative list of species can be found in Appendix 2). Shrubs will be planted in the fall or spring, while the grasses will be seeded concurrently with the construction. Though grass seeding will be concurrent with the construction, some erosion of the slopes may occur. The extent of which is dependent upon how quickly the vegetation becomes established (see figure lb).

Perennial side channel construction will increase the amount of winter rearing habitat available to juvenile salmonids by approximately 2340 square feet.

The discussion so far has been limited to a description of the end products realized immediately or within one year of completion of the project. Over an extended period of time other changes will occur. For example, after approximately 20 years the cover structure will have begun to decay. By this time the banks should have become stable enough to be unaffected by the loss of the logs, Within 20 years the lattice structure will also have decayed and the vegetation will have become well established. As the amount of vegetation increases and grows it will progressively decrease the amount of sediment reaching the stream , This then means that over time the slopes themselves will retain their 30-40% slope. Side channels should remain fairly constant over a long period of time.

NET BENEFITS

The benefits of this project can be classified under the areas of sediment reduction and increased habitat. Sediment entering the stream will be reduced in two ways. Some reduction will be due to the increased vegetation which holds the soil on the slopes from being washed down to the stream. The major reduction of sediment, however, will occur because of the decrease of large amounts of soil from the banks breaking off into the stream. It has been determined, by aerial photo comparisons, that annually at least 15 tons of soil has eroded off the banks of the project sites. Erosion should be greatly reduced at the project sites.

Increased habitat is the other area of benefits for this project. These benefits occur in several forms. One form is the overhanging banks, which create cover. It is estimated that 2,097 sq. ft. of overhanging bank cover will be created from this project. An additional 2,334.6 sq. ft. area, in the form of side channels, will be added for use as winter rearing habitat for juveniles. When the vegetation planted on the banks has become established, there will be an increased amount of shading to the stream. The new vegetation will also provide deciduous matter to the stream, contributing to the increase in primary macroinvertebrate production.

APPENDIX I: **MATERIALS**

SITE #	1	2	3	4	5	ACTUAL TOTAL	AMTS. ORDERED
# LATTICE LOGS (33' @ 8-12" DIA.)	14	13	35	28	28	118	120
# ANCHOR LOGS (10-12' @ 6-8" DIA.)	36	28	78	61	64	267	270
# SILLS LOGS (33' @ 14-16" DIA.)	7	6	13	14	14	54	60
# STAKES (6' @ 4-6" DIA.)	48	45	120	96	96	405	450
# REBAR (1/2" x 20")	156	120	332	260	272	1140	1160
CURLEX (4' X 300')						2 ROLLS	2 ROLLS
LAGS (10")	48	45	120	96	96	405	450
LAGS (16")	48	45	120	96	96	405	450

APPENDIX II:
Plants which may be used for riparian revegetation

Conifers
- Pinus ponderosa - Ponderosa Pine
- Pseudotsuga menziesii - Douglas Fir
- Picea engelmannii - Engelmann Spruce
- Abies lasiocarpa - Subalpine Fir
- Pinus contorta - Lodgepole Pine

Deciduous trees & shrubs
- Salix spp. (native willow cuttings)
- S. scouleriana - scouler willow, mountain willow
- P. tremuloides - quaking aspen

Symphorocarpus sp. - snowberry

Cornus stolonifera - redosier dogwood

Crataegus douglasii - douglas hawthorn, black hawthorn

Alnus sinuata - sitka alder
A. tenuifolia - thin leaf alder
A. incana - mountain alder

Acer glabrum - Rocky Mountain Maple

Betula papyrifera - paper birch
B. occidentalis - water birch

Prunus virginiana - chokeberry

Rosa sp. - rose
Sambucus cerula - blue elderberry

Grasses
- Annual Ryegrass
- Pubescent Wheatgrass
- Streambank Wheatgrass
- Intermediate Wheatgrass
- Timothy
- Reed Canarygrass
- Meadow foxtail
- Hard fescue
- Kentucky bluegrass

Legumes
- White clover
- Alsike clover
- Yellow sweet clover
- Cicer Milkvetch
- Alfalfa

APPENDIX B

LIST OF COOPERATORS

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